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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/812,480

03/30/2004

Deenesh Padhi

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EXAMINER

MALSAWMA, LALRINFAMKIM HMAR

ART UNIT

PAPER NUMBER

2823

DATE MAILED: 02/24/2005

7590 02/24/2005

Patent Counsel, MS/2061
Legal Affairs Department
Applied Materials, Inc.
P.O. Box 450A
Santa Clara, CA 95052

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/812,480

Applicant(s)

PADHI ET AL.

Examiner

Lex Malsawma

Art Unit

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on Mar. 30, 2004 through Dec. 07, 2004.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-42 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-42 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 30 March 2004 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date <u>6/16, 8/11, 10/8, 12/7/2004</u> . | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Information Disclosure Statement

1. The information disclosure statements filed June 14, 2004, August 11, 2004, October 08, 2004 and December 07, 2004 have been considered; however, the large number of references precludes a thorough review of each reference, therefore, the Applicant is requested to identify any specific references, which are believed to have particular significance in the prosecution of this application or which are considered material to the patentability of the pending claims, for further consideration by the examiner.

Claim Objections

2. Claim1 is objected to because of the following informalities:

At the end of claim 1, "layer" should be inserted after "passivating".

Appropriate correction is required.

Claim Rejections - 35 USC § 102

3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

(e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application by another who

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has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371(c) of this title before the invention thereof by the applicant for patent.

The changes made to 35 U.S.C. 102(e) by the American Inventors Protection Act of 1999 (AIPA) and the Intellectual Property and High Technology Technical Amendments Act of 2002 do not apply when the reference is a U.S. patent resulting directly or indirectly from an international application filed before November 29, 2000. Therefore, the prior art date of the reference is determined under 35 U.S.C. 102(e) prior to the amendment by the AIPA (pre-AIPA 35 U.S.C. 102(e)).

4. Claims 1-5, 8-22, 24, 26, 28 and 29 are rejected under 35 U.S.C. 102(e) as being anticipated by **Farrar** (6,424,289 B1).

Regarding claims 1-5, 8-11, 20, 21, 24 and 28:

Farrar discloses a method of processing a semiconductor substrate, comprising the steps of:

depositing a protective layer 21 (Fig. 8 and Col. 4, lines 64-67, or protective layer comprising "17" and "21" in reference to claims 24 and 28) on a substrate surface comprising a conductive element 1 (copper, Col. 3, lines 20-21), wherein the substrate surface comprises a dielectric material 19 in which the conductive element is disposed (note in the embodiment shown in Figs. 1-6, Farrar discloses the dielectric material "7" is polyimide, Col. 3, lines 24-27, which is a low-k dielectric material typically having a dielectric constant ranging from 2.5 to 3.5), wherein the protective layer comprises photoresist that is formed by depositing the photoresist over the substrate surface, exposing and developing the photoresist under conditions

that do not degrade the substrate surface to expose a selected region of an underlying layer (note item 1, 17 or 19 in Fig. 8);

selectively removing a portion of the protective layer to expose the conductive element of the substrate surface;

depositing a metallic passivating layer 23 (Fig. 9) onto the exposed conductive element, wherein the passivating layer comprises tantalum, tungsten, titanium, etc. (Col. 5, lines 8-12); and

removing at least a portion of the protective layer 21 (or at least a portion of the thickness, i.e., the entire thickness is removed, therefore, at least a portion of the thickness is removed) from the substrate after the deposition of the metallic passivating (Figs. 9-10 and Col. 5, lines 21-29), wherein the protective layer (photoresist) is removed by wet chemical etch. Therefore, this claim is anticipated.

Regarding claims 12 and 13:

These claims depend from claim 9 and contain limitations associated with an amorphous carbon protective layer; however, claim 9 only requires that the organic material for the protective layer be either photoresist or amorphous carbon. Therefore, regardless of the additional limitations associated with an amorphous carbon layer, Farrar anticipates the currently claimed invention because Farrar discloses the organic material is photoresist.

Regarding claims 14-16 and 29:

Farrar discloses the protective layer 21 comprises a dielectric material (i.e., a photoresist) that is deposited over the substrate surface; selectively etching the dielectric layer under conditions that do not degrade the substrate surface (Figs. 8 and 10); and removing the dielectric

layer 21 after deposition of the passivating layer 23 by etching using a wet etch (Col. 5, lines 21-29).

Regarding claims 17-19 and 26:

Farrar discloses depositing an intermediate layer 17 (Figs. 7-8) on the substrate surface; depositing a protective layer 21 on the intermediate layer; selectively removing the protective layer to expose the intermediate layer; and selectively removing the intermediate layer under the conditions that do not degrade the conductive element 1 (Col. 4, lines 63-67), wherein the intermediate layer 17 comprises an etch stop (of dielectric material, e.g., silicon nitride, Col. 4, lines 61-63) and the protective layer 21 comprises a photoresist.

Regarding claim 22:

In the instant claim, metal layers “23 and 13” (in Fig. 11) will be referred to as the metallic passivating layer and dielectric layer “17” will be referred to as the protective layer. Accordingly, Farrar discloses depositing the metal passivating layer by electroless deposition (Col. 5, lines 30-32 and lines 4-8).

5. Claims 36, 38, 39 and 42 are rejected under 35 U.S.C. 102(e) as being anticipated by Shin et al. (US 2002/0173129 A1; hereinafter “**Shin**”).

Regarding claims 36, 38, 39 and 42:

Shin discloses a method of processing a semiconductor substrate, comprising the steps of:

depositing a metallic passivating layer 79 (Fig. 9D) onto a substrate surface comprising a conductive element 77, wherein the passivating layer is deposited as a continuous film (Fig. 9D and paragraph 0083);

masking the passivating layer to protect the underlying conductive element of the substrate surface (Fig. 9D);

removing the unmasked passivating layer by etching to expose the underlying substrate surface (Fig. 9E); and

removing the mask 86 from the passivating layer (Figs. 9D-9E). Therefore, these claims are anticipated.

Claim Rejections - 35 USC § 103

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

7. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

8. Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over **Farrar** (6,426,289 B1) in view of Jiang et al. (6,303,200 B1; hereinafter "**Jiang**").

Regarding claim 6:

Farrar anticipates the method of claim 1 but **lacks** treating the substrate surface to expose the conductive element prior to deposition of the protective layer. Jiang **teaches** a method of electrolessly plating/passivating a conductive element 10 (Fig. 3) by selectively forming a protective layer 40 (Fig. 3) on an insulating layer, which has been previously opened to expose the conductive element (see paragraph bridging Cols. 3-4). Jiang further teaches that such a process prevents oxide from forming on the surface of the conductive element (Col. 1, lines 36-43). It would have been obvious to one of ordinary skill in the art to modify Farrar by first exposing the conductive element and then selectively forming a protective layer, as taught by Jiang, because such a modification would prevent oxide from forming on the surface of the conductive element.

9. Claim 7 is rejected under 35 U.S.C. 103(a) as being unpatentable over **Farrar** (6,424,289 B1) in view of Sosnowski et al. (3,839,067; hereinafter "**Sosnowski**").

Regarding claim 7:

Farrar anticipates the method of claim 1 and discloses that the protective layer 21 (Fig. 8) is photoresist. However, Farrar **lacks** specifically disclosing a process for depositing the photoresist. Sosnowski is **cited only to show** it was very well known and conventional in the art to deposit a photoresist film by spin-on deposition (note Col. 5, lines 8-10). It would have been obvious to one of ordinary skill in the art to modify Farrar by specifically reciting that the

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protective layer (i.e., the photoresist) is deposited by a spin-on deposition process because such a process was well-known and conventional in the art for depositing a photoresist layer (as shown by Sosnowski).

10. Claims 23 and 25 are rejected under 35 U.S.C. 103(a) as being unpatentable over **Farrar** (6,424,289 B1) in view of Amelio et al. (4,639,380; hereinafter "**Amelio**").

Regarding claims 23 and 25:

Farrar anticipates the method of claims 22 and 24 and discloses electrolessly depositing a metallic passivating layer by depositing an initiation layer (i.e., a seed layer 26, Col. 5, lines 4-8); and depositing a metallic passivating layer on the initiation layer by electroless plating (Col. 5, lines 30-32). Farrar **lacks** specifically disclosing a cleaning step after depositing the initiation layer; however, it is important to note that Farrar does not disclose specific process steps performed during the electroless plating process, probably because electroless processes were very well known in the art and one of ordinary skill in the art would already recognize specific process steps associated with an electroless plating process. Amelio is **cited to show** it was well known in the art to include a cleaning step prior to depositing a metallic layer (i.e., a metal plating) in an electroless plating process. Amelio discloses that a typical electroless plating process includes forming a seed layer (Col. 1, lines 39-40); cleaning the substrate after forming the seed layer (Col. 1, lines 58-61); and depositing a metallic passivating layer. Therefore, it would have been obvious to one of ordinary skill in the art to modify Farrar by specifically reciting that a cleaning step is performed after depositing the initiation/seed layer because

Amelio shows/teaches that an electroless plating process typically incorporates such a cleaning step in order to ensure the quality of the metal coating (note Amelio, Col. 1, lines 59-61).

11. Claims 30-33 and 35 are rejected under 35 U.S.C. 103(a) as being unpatentable over **Farrar** (6,424,289 B1).

Regarding claims 30-33 and 35:

These claims are essentially drawn to a system for performing the method of claims 1, 10, 17, 22 and/or 23. Since Farrar discloses/anticipates all process limitations of the currently claimed invention, it would be readily obvious to one of ordinary skill in the art that Farrar must incorporate a system comprising means for performing the process steps recited in at least claims 1, 10, 17, 22 and/or 23. Accordingly, these claims are held obvious over Farrar (if not anticipated).

12. Claims 27 and 34 are rejected under 35 U.S.C. 103(a) as being unpatentable over **Farrar** (6,424,289 B1) in view of Hashimoto et al. (5,656,128; hereinafter "**Hashimoto**").

Regarding claim 27:

Farrar anticipates the method of claim 24 but **lacks** incorporating an amorphous carbon protective layer. Hashimoto **teaches** that utilizing an amorphous carbon film with a photoresist film improves resolution (i.e., "photolithographic resolution") because the amorphous carbon film serves as an anti-reflective film (note Col. 1, lines 48-59 and Col. 2, lines 7-13). It would have been obvious to one of ordinary skill in the art to modify Farrar by incorporating an amorphous carbon film as taught by Hashimoto because such a modification could significantly

improve “photolithographic resolution”. Note: When an amorphous carbon film is incorporated with the photoresist film (in Farrar), the following process steps would result: the amorphous carbon film is deposited over the substrate but underneath the photoresist film, and the amorphous carbon film (and photoresist film) is etched under conditions that do not degrade the conductive element, i.e., the etching is performed to expose the conductive element (as shown in Fig. 8 of Farrar), which is materially different from the photoresist and the amorphous carbon films, accordingly, the conductive element would not be degraded by the etching conditions.

Regarding claim 34:

This claim is essentially drawn to a system for performing the method of claim 27. Since Farrar (in view of Hashimoto) discloses all process limitations of claim 27, it would be readily obvious to one of ordinary skill in the art that Farrar (in view of Hashimoto) would incorporate a system comprising means for performing the process step recited claim 27. Accordingly, these claims are held obvious over Farrar in view of Hashimoto.

13. Claim 37 is rejected under 35 U.S.C. 103(a) as being unpatentable over **Shin** (US 2002/0173129 A1) in view of Okumura et al. (4,954,218; hereinafter “**Okumura**”).

Regarding claim 37:

Shin anticipates the method of claim 36 and specifies that the mask 86 (Fig. 9D) is a patterned photoresist mask; however, Shin **lacks** specifically disclosing how the mask is removed. Okumura **teaches** it was very well known in the art to remove a photoresist mask by ashing (note Col. 2, lines 52-53). Since Shin does not specify how the photoresist mask is removed, it would have been obvious to one of ordinary skill in the art to modify Shin by

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specifically reciting that the mask is removed by ashing because Okumura teaches/shows it well known in the art to remove a photoresist mask by ashing.

14. Claims 40 and 41 are rejected under 35 U.S.C. 103(a) as being unpatentable over **Shin** (US 2002/0173129 A1) in view of **Farrar** (6,424,289 B1).

Regarding claims 40 and 41:

Shin anticipates the method of claim 36 but **lacks** the conductive material specifically comprising copper or the passivating layer being selected from the group specified in claim 41. However, it is noted Shin does not specify any particular type of material for the passivating layer 79 (Fig. 9D) and Shin does not exclude any particular type of material that may be used for the conductive material 77. Farrar is **cited primarily to show** that an interconnect structure, similar to that disclosed by Shin, can be formed of a copper conductive material 1 and a passivating material 13 comprising tantalum, tungsten, titanium, etc., (Col. 5, lines 30-39). Since Shin does not (1) exclude any type of material from being used for the conductive material or (2) specify any particular material for the passivating layer; given Farrar's disclosure, it would have been obvious to one of ordinary skill in the art to modify Shin by specifically using copper for the conductive material and titanium (for example) for the passivating layer because Farrar shows/teaches that such a combination of materials is well suited for an interconnect structure, which is similar to Shin's structure. Note that it has been held to be within the general skill of a worker in the art to select a known material on the basis of its suitability for the intended use as a matter of obvious design choice. *In re Leshin*, 125 USPQ 416.


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Conclusion


15. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Lex Malsawma whose telephone number is 571-272-1903.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudhuri can be reached on 571-272-1855. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Lex Malsawma 

February 15, 2004


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